Using Sun™ Storage 7000 Unified Storage System With VMware ESX Server

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Table of Contents

1.0 Objective....4
1.1 NFS (NAS) Access....4
1.2 iSCSI Access....5
2.0 Configuring Sun Storage 7000 Unified Storage System for VMware ESX....6
2.1 Security....6
2.2 Network....8
2.3 Pool....10
2.4 Projects and Shares....10
2.4.1 Creating a New Project....11
2.4.2 Creating a New Filesystem (NFS)....11
2.4.3 Creating a New LUN (iSCSI)....12
2.5 Analytics....13
3.0 Configuring VMware ESX With Sun Storage 7000 Unified Storage System....14
3.1 Changing NFS Settings in VMware ESX....14
3.2 Network....14
3.3 iSCSI Access....15
3.4 Enabling NFSv3 Access....17
4.0 Advanced Data Services....18
4.1 Snapshots....18
4.2 Cloning a Snapshot....18
4.3 Replication....19
4.4 Accessing Replicated Data....19
5.0 Appendix....20
6.0 Glossary....22
7.0 For More Information....23
8.0 Licensing Information....24

1.0 Objective

This Quick Start Guide is intended to give an administrator a quick overview on how to quickly set up a Sun™ Storage 7000 Unified Storage System to use with a VMware ESX Server. Both NFS (NAS) and iSCSI protocols are addressed. This document assumes the administrator is familiar with both Sun Storage 7000 Unified Storage System concepts as well as VMware ESX concepts.

1.1 NFS (NAS) Access

The following diagram gives an overview of accessing the Sun Storage 7000 Unified Storage System using the NFS (NFSv3) protocol to host Virtual Machine Disk Format (vmdk). An NFS file system is exported from the Sun Storage 7000 Unified Storage System and mounted using the `vmkernel` in the VMware ESX host.

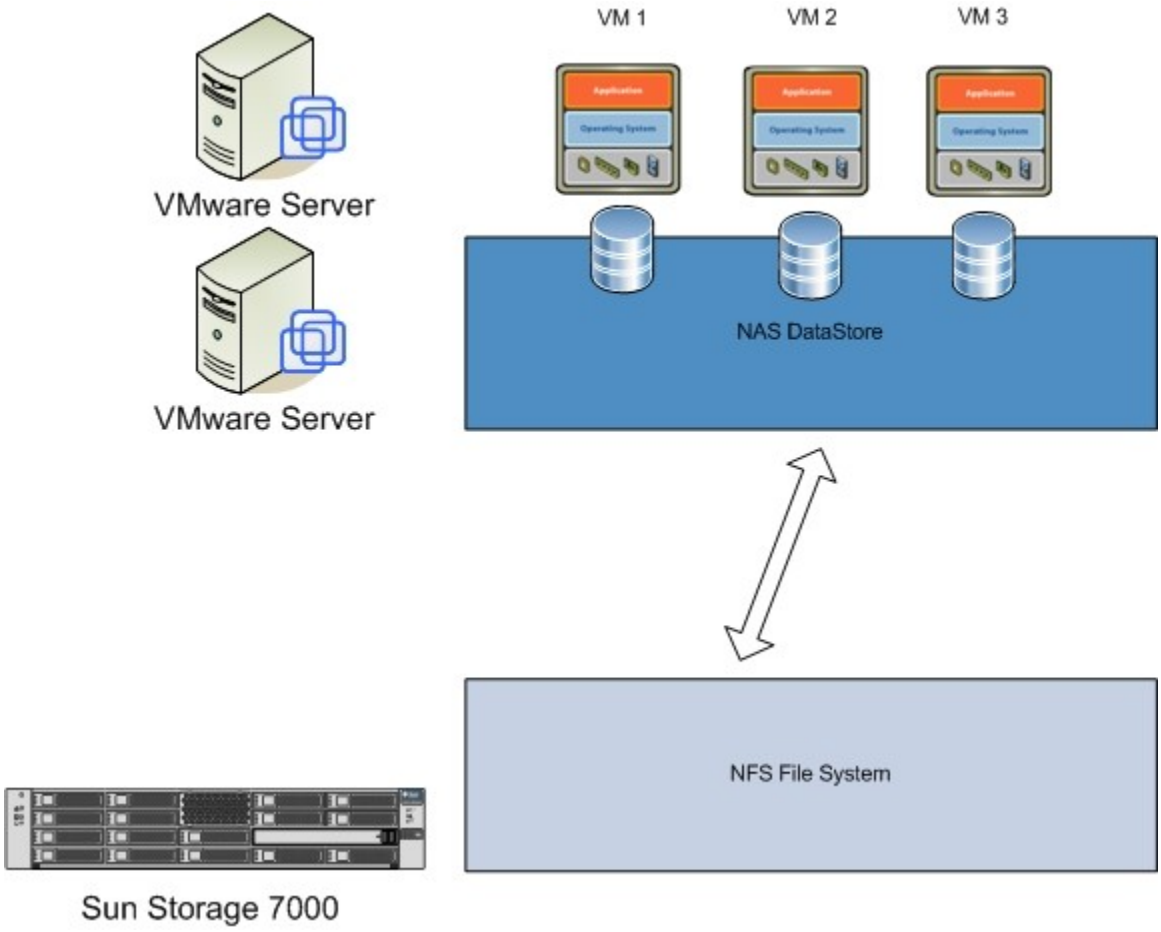

Figure 1: NFS Access

1.2 iSCSI Access

The diagram below gives an overview of accessing the Sun Storage 7000 Unified Storage System using the iSCSI protocol to host Virtual Machine Virtual Disks (vmdk). An iSCSI LUN is exported from the Sun Storage 7000 Unified Storage System and attached using the `vmkernel` in the VMware ESX host. A VMFS3 file system can be created on the iSCSI LUN to host `vmdks`, or the iSCSI LUN can be attached directly to a virtual machine using Raw Device Mapping (RDM).

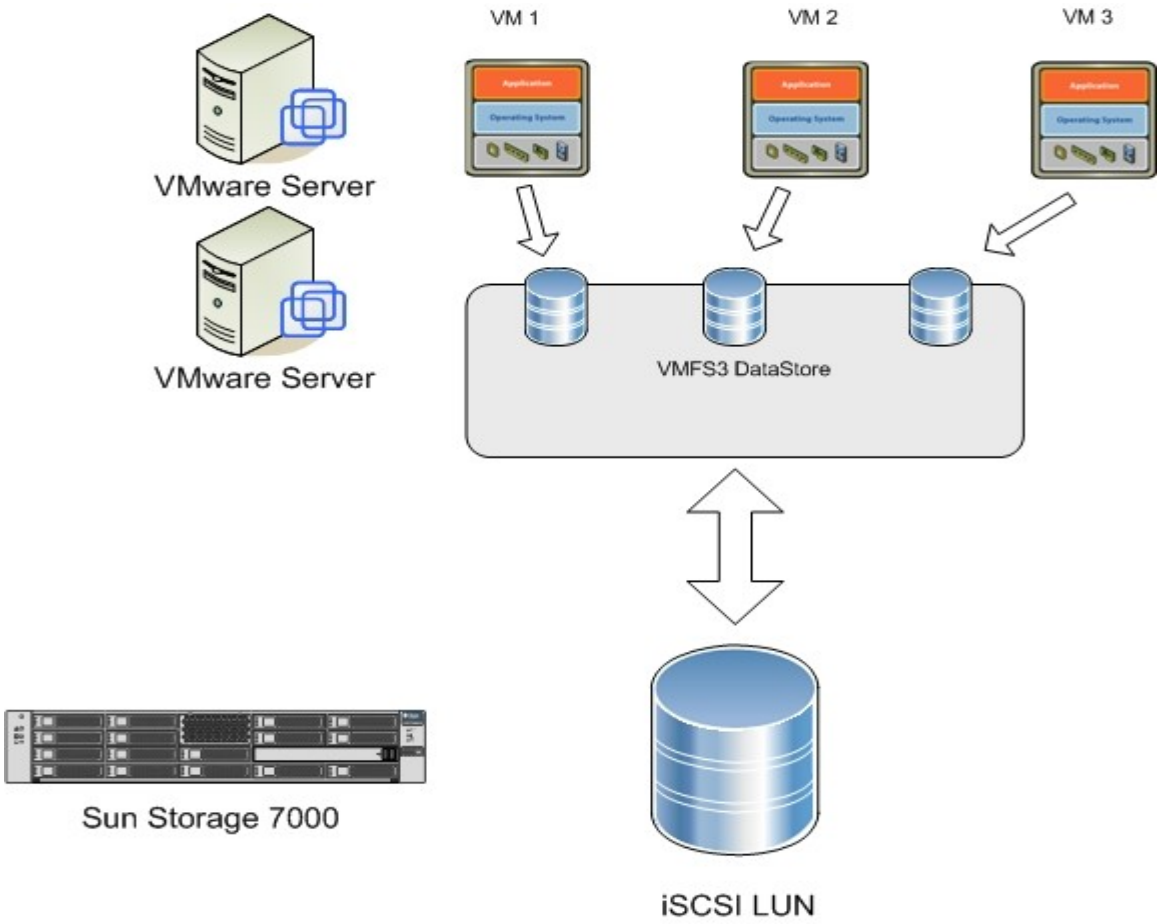

Figure 2: iSCSI Access

2.0 Configuring Sun Storage 7000 Unified Storage System for VMware ESX

2.1 Security

It is recommended that you create a local user on the Sun Storage 7000 Unified Storage System that is associated with a role that allows limited configuration and control for shares within a specific project dedicated to VMware ESX use. That project is first created by the super-user role.

For that purpose, a role called *VMUser_Role* is created in **Configuration** -> **Users** -> **Roles**. This role is given access to two projects, *vm-nfs* and *vm-iscsi*. The role will have the ability to perform operations in those projects only. The role has also been given authorization for using Analytics and Worksheets as well as Replication. Specific policies around this role may vary from the example.

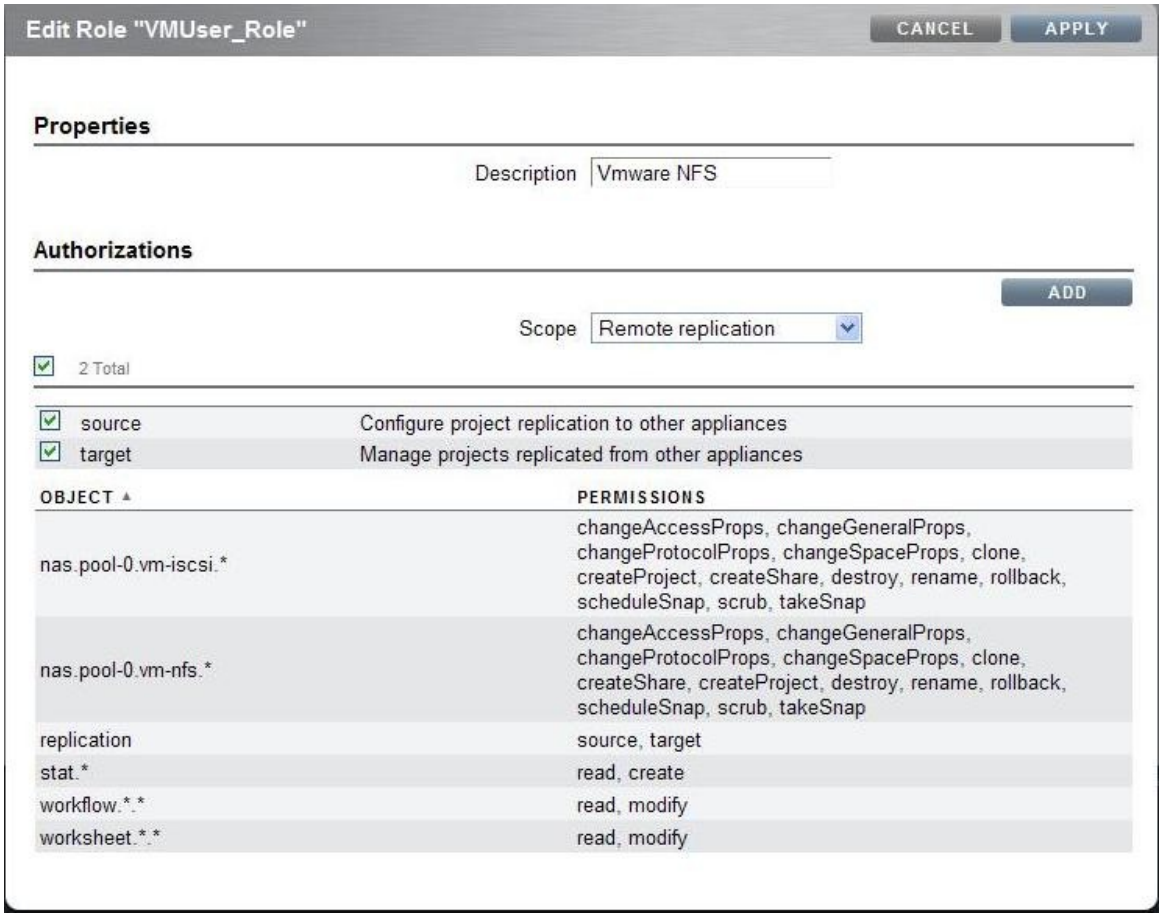

Figure 3: Roles

Once the role is created, the next step is to create a user that can be associated with this role. In the example shown, the user is created as a local user on the Sun Storage 7000 Unified Storage System. This user could also be maintained in a directory service. Note that this user configuration is solely to

allow administration rights on the Sun Storage 7000 Unified Storage System; it is not for file system ownership or file creation privileges. The user should also be associated with the built-in "basic" role as well as the *VMUser_Role* configured above.

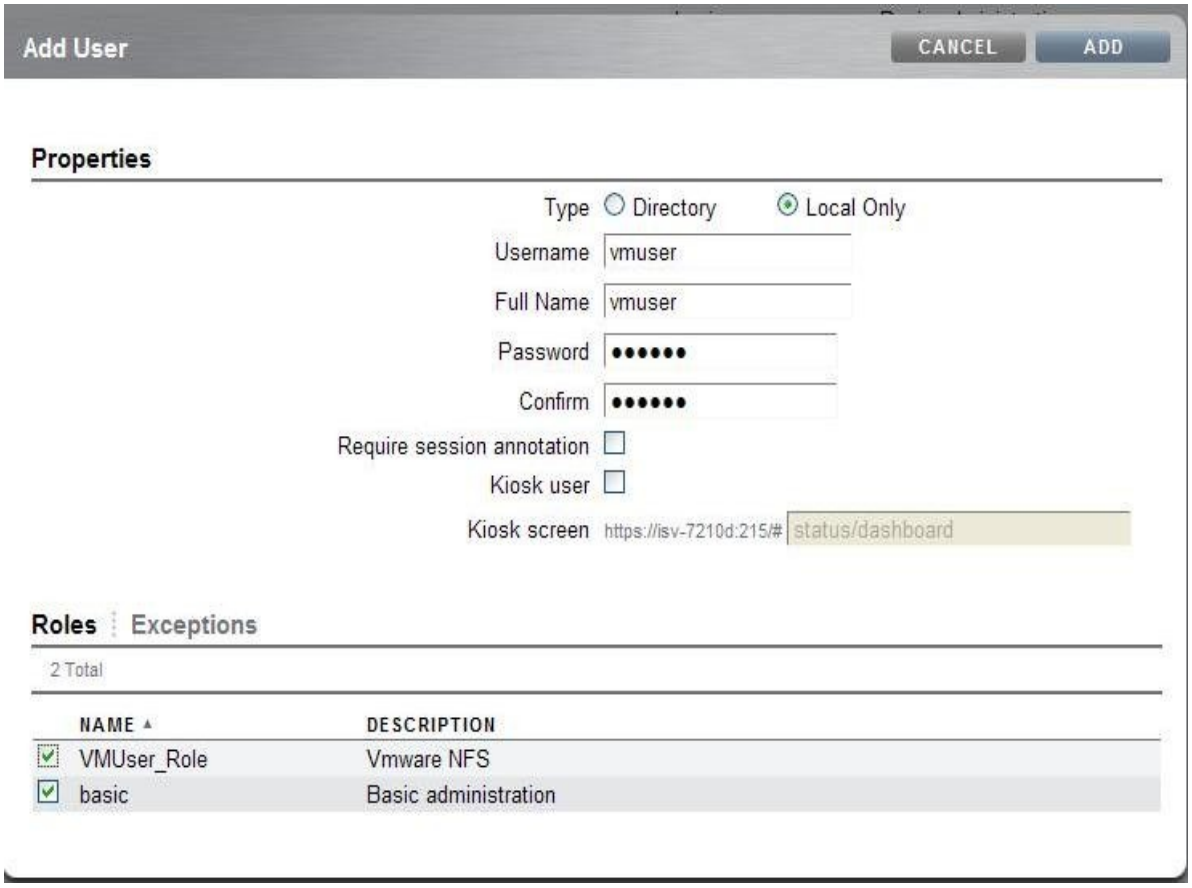

Figure 4: Adding Local User

The final (optional) step is to upload an SSH Public Key for the user to allow administration and scripting without having to enter a password for every login.

1. On a UNIX® or Microsoft Windows client or a VMware Remote CLI virtual appliance, log in as the `vmuser` and generate keys:

   ```
   $ ssh-keygen -t rsa
   $ ssh-keygen -t dsa
   ```

2. The above steps will create public key files in `~/.ssh/id_rsa.pub` and `~/.ssh/id_dsa.pub`.
3. Log in to the Sun Storage 7000 Unified Storage System as the `vmuser`.
4. Under **Configuration** -> **Preferences**, click (+) to add an entry.
5. Choose either **RSA** or **DSA**.

6. Copy the contents of the `.pub` file. (Copy only the key itself, not the type field or the comment field.) Paste it in the entry box. Next copy and paste (or type) an optional comment to clearly indicate who the key is for.

Figure 5: SSH Public Keys

7. Click **Apply** from the main screen to complete the procedure.
8. Test by running a simple command to check that you are not prompted for a password. You may be prompted to accept the Sun Storage 7000 Unified Storage System key the first time the command is run.

```
$ ssh -l vmuser <Sun Storage 7000 Unified Storage System IP> show
```

2.2 Network

There are no special network requirements mandated for VMware ESX interoperability. All methods of networking, Link Aggregation, IPMP, 10 Gbe, are supported. It is recommended that a private network be configured to handle the storage traffic between the VMware ESX servers and the Sun Storage 7000 Unified Storage System. It is also recommended that some level of redundancy be configured using either Link Aggregation or IPMP.

The examples below show an interface (Private-Net) created from a Link Aggregation of two physical 1 Gb Ethernet ports (PrivNet-Aggregation). Those ports are also configured for LACP. Consult your switch vendor documentation for details on enabling LACP and Link Aggregation at the switch level.

Datalink Configuration Example

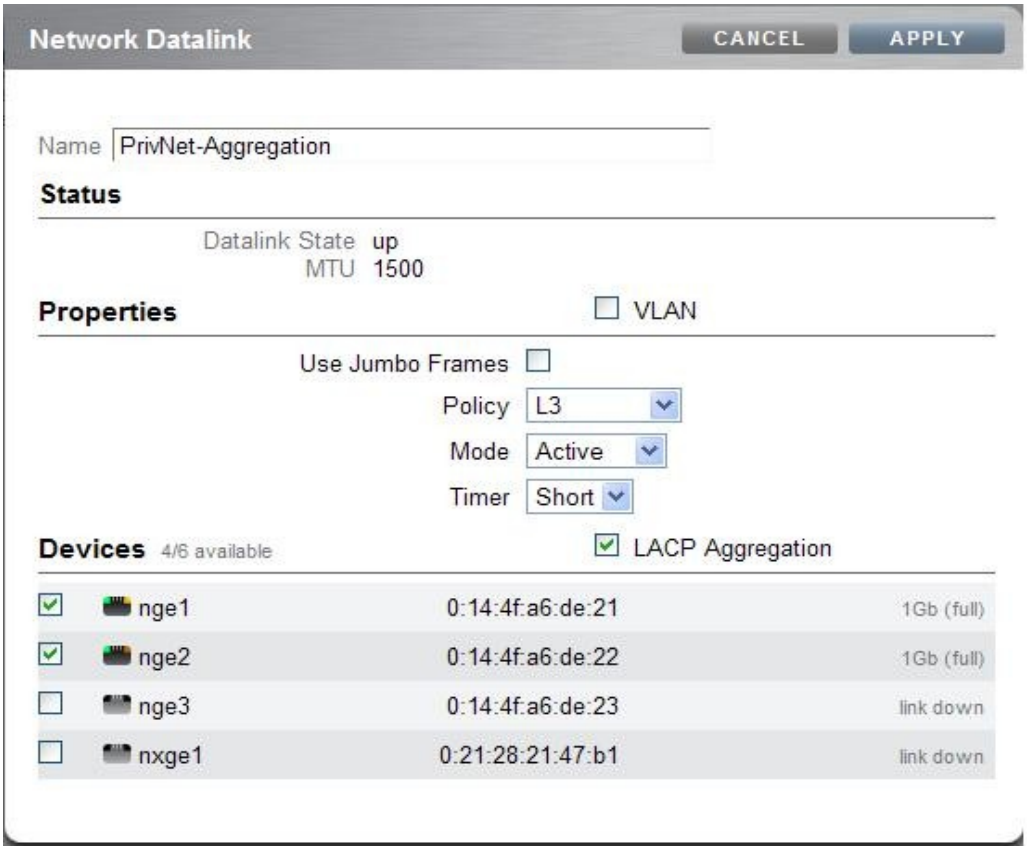

Figure 6: Datalink Example

Interface Configuration Example

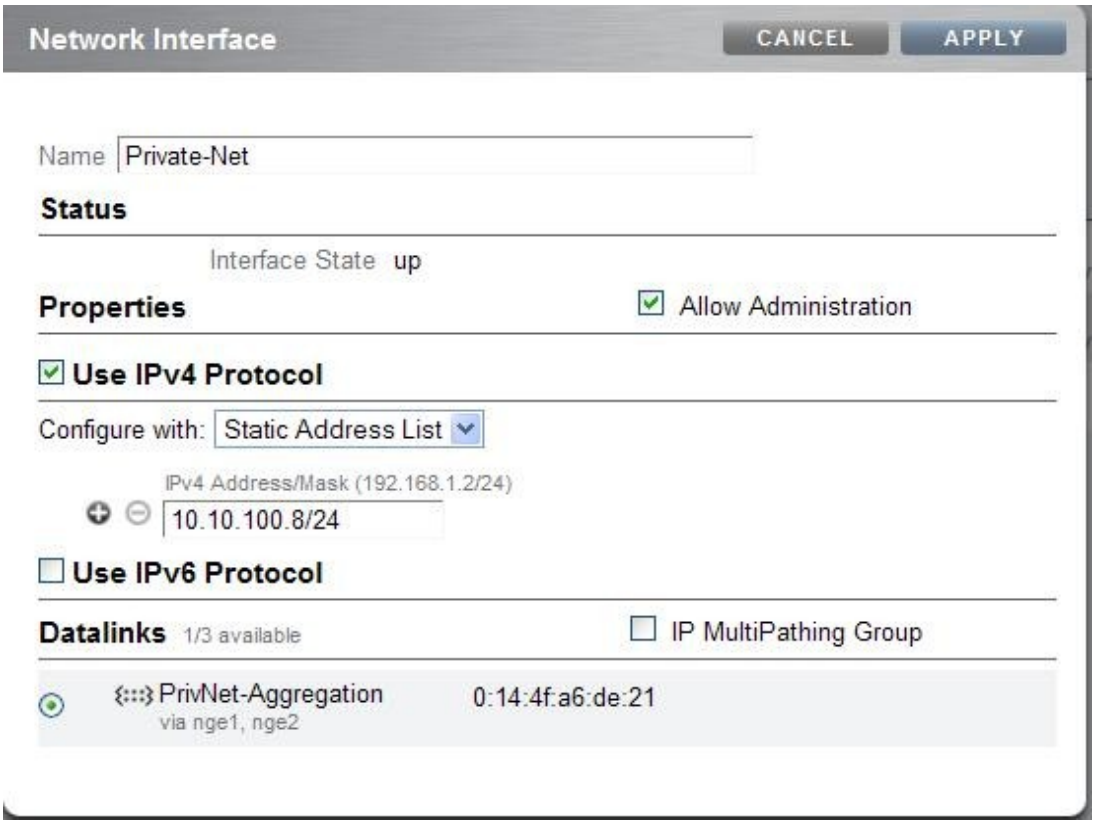

Figure 7: Interface Example

2.3 Pool

Configuring the pool storage RAID layout is a balance between availability, capacity and performance. As can be seen during pool configuration, the Sun Storage 7000 Unified Storage System BUI gives a description plus the relative tradeoffs around availability, capacity and performance. The administrator must weigh all three factors when deciding on a data profile. For VMware ESX and its highly random I/O nature, the best performance is usually found with the Mirror profile.

Also, depending on the Sun Storage 7000 Unified Storage System model, you may also have to decide on a data profile for any Log SSDs that are present in the configuration. Striping the Log devices should give the best performance. Mirroring the Log Devices will give an extra degree of Log availability; however, while losing a Log Device may impact write performance, it will not impact overall availability of the pool. The writes will go directly to disk, but possibly at lower performance levels.

2.4 Projects and Shares

Projects and shares should be configured to present NFSv3 mount points or iSCSI LUNs to the VMware ESX servers. The number of shares will be dependent on ESX storage sizing needs and other business factors such as snapshot and cloning granularity. Also, project layouts should be considered if replication is going to be implemented. The Sun Storage 7000 Unified Storage System replicates at the

project level. If you have differing replication schedules for different types of virtual machines (or even subsets of virtual disk types, OS/boot versus production data) you should configure multiple projects, each to replicate on their own schedule.

For VMware ESX, it is recommended that you turn off **Update access time on read** for NFS filesystems. For the rest of the options, the defaults are sufficient for most general deployments. If you are going to create multiple shares under the same project you can change the properties at the project level and those properties will be inherited by all shares in the project. Individual properties can be overridden at the share level as needed.

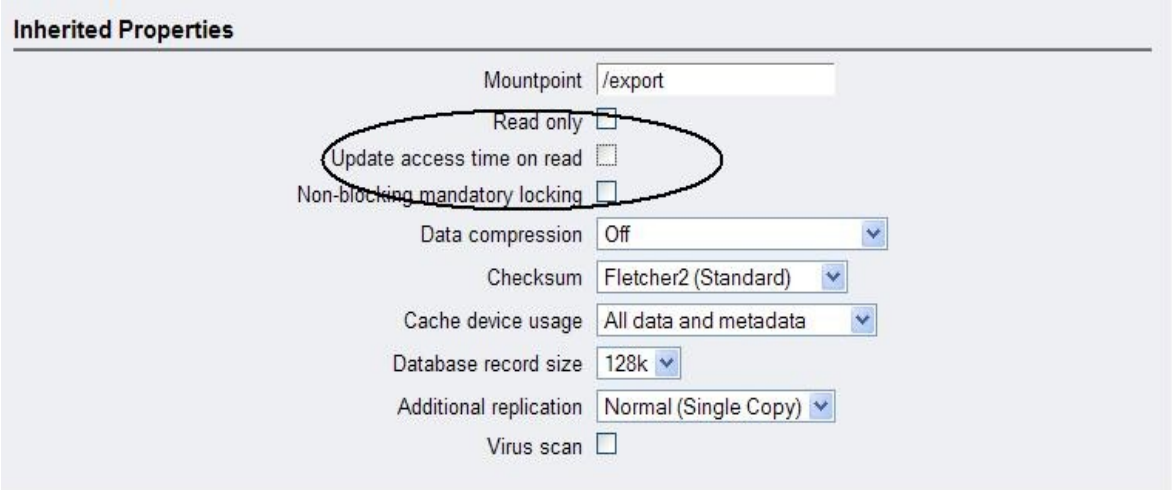

Figure 8: File System Properties

2.4.1 Creating a New Project

To create a new project:

1. Select C**onfiguration** -> **Shares** -> **Projects.**
2. Click (+) to add new **Project**.
3. Give it a name and click **Apply**.
4. Click the **Edit** icon next to **Project name** to enter **Project Properties**.

2.4.2 Creating a New Filesystem (NFS)

To create a new share:

1. Select **Configuration** -> **Shares**.
2. Click (+) to add a new **Filesystem**.
3. Use the drop-down menu to select which project the share should go into.
4. Give the share a name. Other fields can be left at the defaults.
5. Click **Apply**.

6. Click the **Edit** icon next to **Share** to change any of the defaults.

By default, all Sun Storage 7000 Unified Storage System filesystems are created under `/export/sharename` mount points. This can be overridden at the project or share level if needed.

2.4.3 Creating a New LUN (iSCSI)

Before creating a new iSCSI LUN, initiator entries should be configured to allow fine-grained access control.

To add an Initiator:

1. Select **Configuration** -> **Services** -> **iSCSI -> Initiators**.
2. Click (+) to add a new initiator.
3. Enter an alias and the IQN of the initiator. The IQN is found in the Storage Adapter section of the ESX VI client application. See section "3.0 Configuring VMware ESX with Sun Storage 7000 Unified Storage System" for more details.
4. Optionally, configure the CHAP settings for unidirectional CHAP. These credentials must match those set on the initiator in ESX.
5. Click **Add** to finish the procedure.

To add a new iSCSI LUN:

1. Select **Configuration** -> **Shares** -> **Luns**.
2. Click (+) to add a new **LUN**.
3. Use the drop-down menu to select which project the LUN should go into.
4. Give the LUN a name. Enter volume size, whether the LUN should be sparse, and the volume block size.
5. Click **Apply**.
6. Click the **Edit** icon to enter the LUN properties. Click the **Protocols** tab.
7. Uncheck **Inherit from project** and **Allow any initiator access**.
8. Check the desired initiator that was configured above.

Figure 9: iSCSI Access Control

The initiator access can also be configured at the project level if all LUNs in a project are going to have the same initiator access.

2.5 Analytics

The following analytics are useful to observe the workloads on the Sun Storage 7000 Unified Storage System:

- NFSv3 operations broken down by file name (NFS only)
  - Allow the administrator to view operations at the virtual disk level.
- NFSv3 operations broken down by client (NFS only)
  - Allow the administrator to view operations on a per ESX Server level.
- Interface bytes as a raw statistic
  - Allow the administrator to view network performance.
- I/O bytes broken down by disk
  - Allow the administrator to view disk I/O bandwidth usage.
- ARC access broken down by Hit/Miss
  - Allow the administrator to view Adaptive Replacement Cache activity.

At the end of this guide is a sample workflow script that will build a worksheet with these Analytics.

3.0 Configuring VMware ESX With Sun Storage 7000 Unified Storage System

3.1 Changing NFS Settings in VMware ESX

By default, VMware ESX has an NFS datastore limit of eight file systems. To change that limit, use the following steps:

1. Log in to Virtual Center.
2. Choose an ESX host.
3. Select **Configuration** -> **Advanced Settings** -> **NFS**.
4. Change **NFS.MaxVolumes** to **32**.
5. Repeat for each ESX Server.

3.2 Network

In order to use NFSv3 or iSCSI to store virtual machines, VMware ESX needs to have an additional network interface configured to allow the `vmkernel` to access the Sun Storage 7000 Unified Storage System.

1. Log in to Virtual Center.
2. Choose an ESX host.
3. Select **Configuration-> Networking**.
4. Click **Add Networking**, choose **Vmkernel**, click **Next**.
5. Select which Virtual Switch you want to create the new `vmkernel` interface on. This could be an existing vSwitch or you could create a new vSwitch on a different network adapter. Click **Next.**
6. Change the label of the interface if needed or click **Next**.
7. Enter an IP address and subnet mask. Click **Next**.
8. Click **Finish**. You may be prompted to enter a gateway for the `vmkernel` interface.
9. Repeat for each ESX Server.

In the example below, two physical NICs (`vmnic2` and `vmnic3`) are configured in vSwitch1 for `vmkernel` access. This provides connectivity to the Sun Storage 7000 Unified Storage System using a private vLAN.

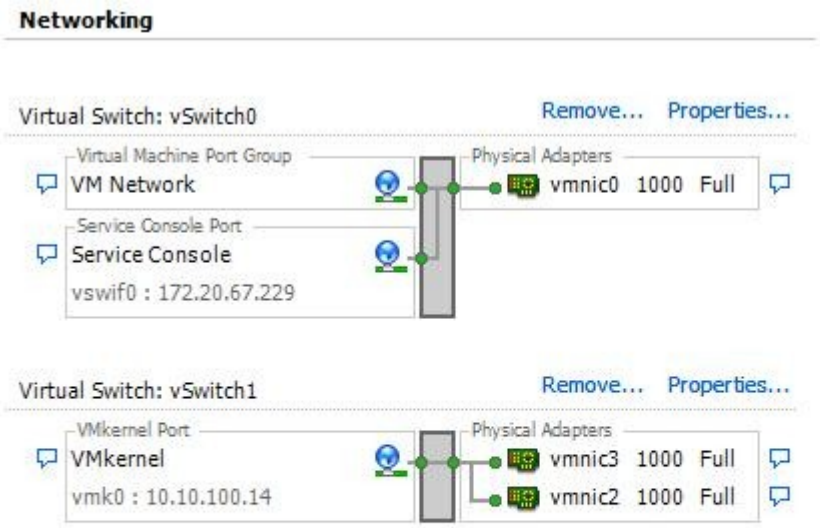

Figure 10: VMware ESX Network Configuration

3.3 iSCSI Access

To enable the built-in VMware ESX iSCSI software initiator:

1. Log in to Virtual Center.
2. Select **Configuration** -> **Storage Adapters**.
3. Select the **iSCSI Software Adapter**. Click **Properties**.
4. Click **Configure**. Check the **Enabled** box. Click **OK**.

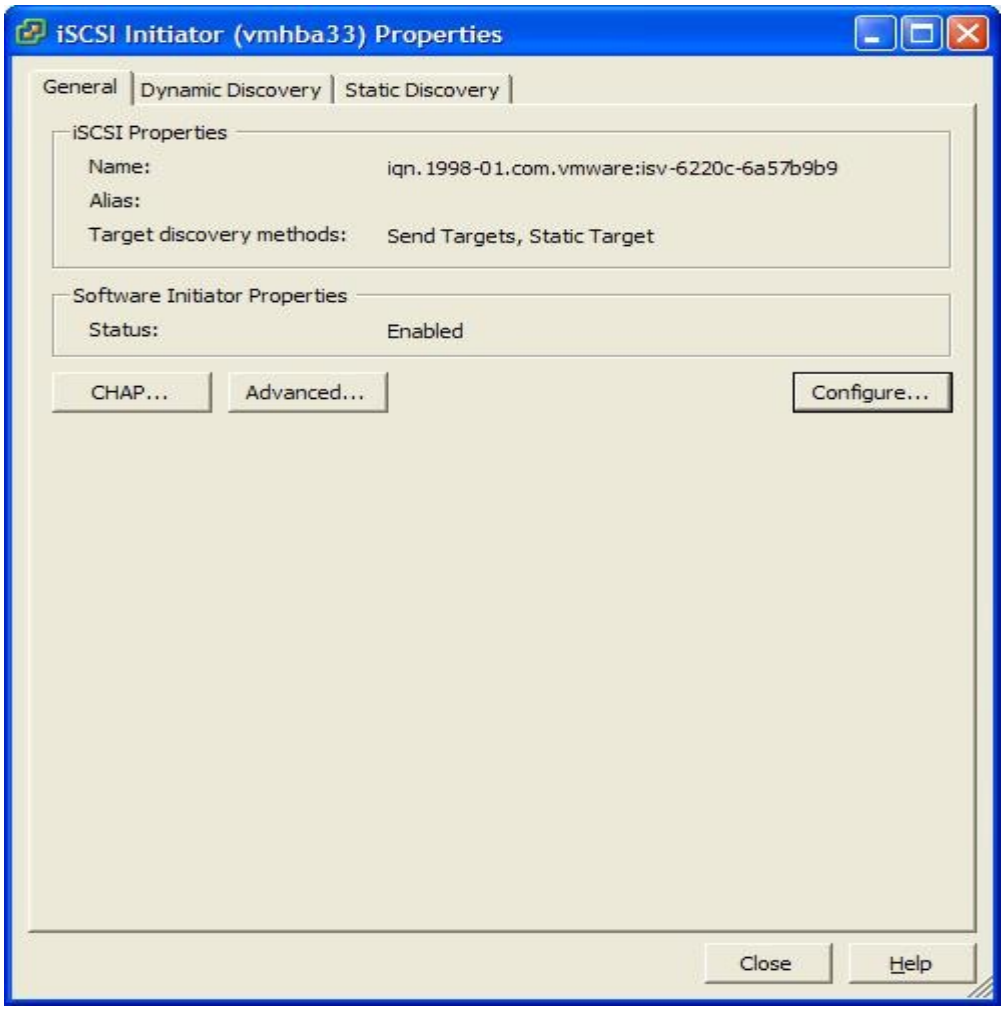

Figure 11: iSCSI Initiator

5. Select the **Dynamic Discovery** tab.
6. Click **Add**. Enter the IP address of the Sun Storage 7000 Unified Storage System. Click **OK**.
7. Click **Close**.
8. Click the **Rescan** link to have VMware ESX discover the Sun Storage 7000 Unified Storage System iSCSI LUNs.
9. It is recommended that you enable any CHAP configuration after all iSCSI LUNs have been discovered.
10. After the Rescan completes, select **Configuration** -> **Storage** to add the iSCSI LUN as a DiskDevice and create a `VMFS3` file system on the LUN. Optionally the iSCSI LUN can be used as a Raw Device Mapping device.

3.4 Enabling NFSv3 Access

1. Log in to Virtual Center.
2. Select **Configuration** -> **Storage** - > **Add Storage**.
3. Choose **Network File System**.
4. Enter the Sun Storage 7000 Unified Storage System name or IP, file system mount point, and a Datastore label.

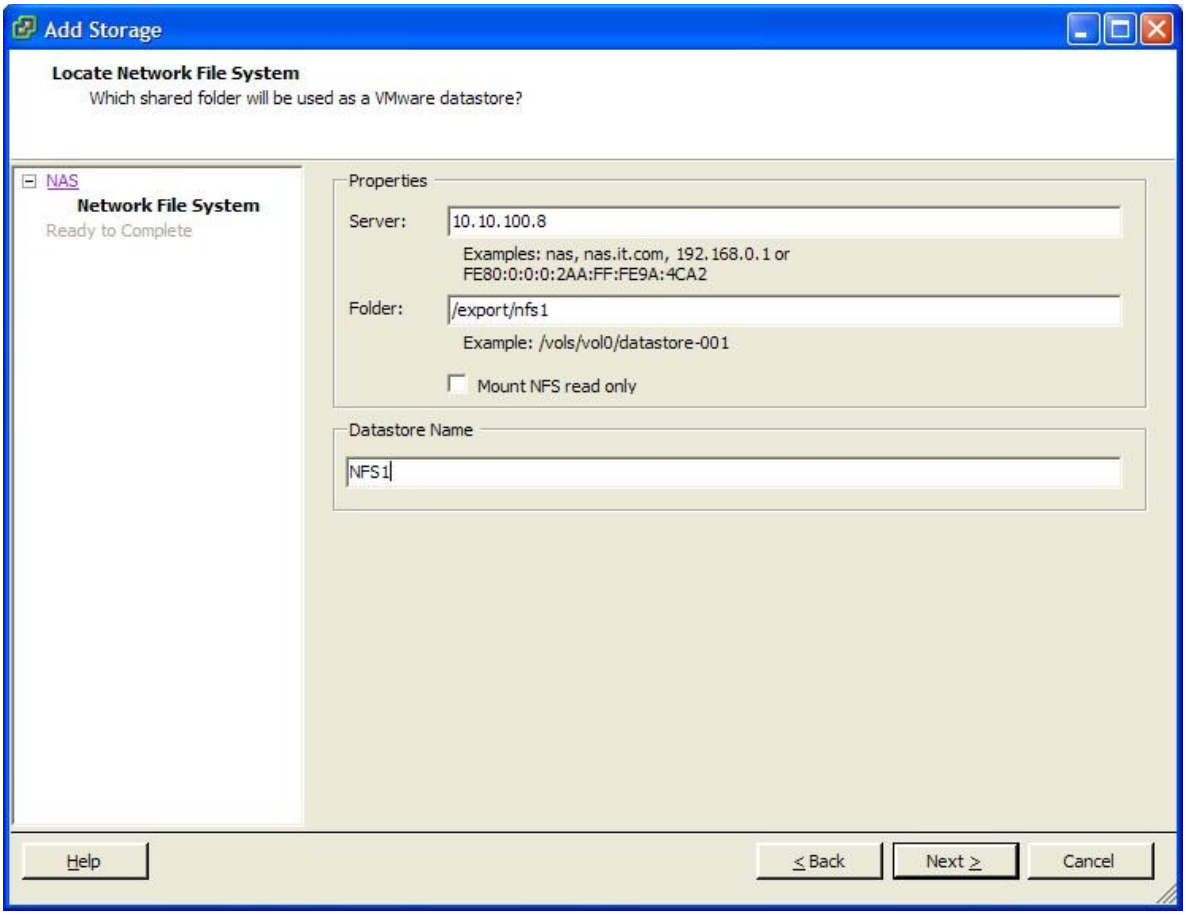

Figure 12: Add NFS Datastore

5. Click **Next**. Click **Finish**.

4.0 Advanced Data Services

The following section gives a high-level overview on how to enable snapshots and replication on the Sun Storage 7000 Unified Storage System to use with VMware ESX. It is outside the scope of this document to delve into the lower-level implementation details for snapshot and replication. You can refer to the online Sun Storage 7000 Help Wiki for details on using both features (or Sun Storage Unified Storage System Administration Guide at http://docs.sun.com/source/820-4167-10/).

4.1 Snapshots

Snapshots can be taken at the project or the share (file system or iSCSI LUN) level.

To take a snapshot use the following procedure:

1. Select **Shares**.
2. Select the Share or Project that you want to create a snapshot on.
3. Select the **Snapshots** tab.
4. Click (+) to add a new manual snapshot or select the **Schedule** tab and click (+) to add a new scheduled snapshot.
5. Click **Apply**.

4.2 Cloning a Snapshot

To access the snapshot as a readable/writable file system or LUN, the snapshot must be cloned and then mounted on the VMware ESX Server.

To clone a snaphost use the following procedure:

1. Select **Shares**.
2. Select the Share or Project that contains the snapshot you wish to clone.
3. Select the **Snapshots** tab.
4. Select the snapshot you wish to clone.
5. Click (+) to **Clone snapshot as a new share**.
6. Give the clone a unique name to identify it as separate from the snapshot. For example: *fs1-clone*.
7. Click **Apply**.

You can now use the procedures for adding a new NFS file system or a new iSCSI LUN to VMware ESX to access the clone.

4.3 Replication

Replication is configured at the project level only. All file systems or iSCSI LUNs contained within a project will be asynchronously replicated on the same schedule to the target system. As the replication is at the project level, this allows the administrator to intelligently group virtual machines or virtual disk layouts based on replication needs. All objects within a specific project will be replicated with the same policy.

To enable replication to another Sun Storage 7000 Unified Storage System:

1. Select **Shares** -> **Projects**.
2. Select the Project you wish to replicate and click the **Edit Entry** icon.
3. Select the **Replication** tab.
4. Click (+) to add a new replication target.
5. Fill in the target address and `root` user password. Select **Continuous** or **Scheduled** mode.
6. Click **Add**.

4.4 Accessing Replicated Data

To access the replicated data on the target system, the system must complete at least one successful replication. After the data has finished replicating, the project can be accessed on the target system.

To access the replicated project, use the following procedure:

1. Log in to the target system.
2. Select **Shares** -> **Replication**.
3. Select the replicated project you wish to access.
4. Click (+) to **Clone (export) this replica**.
5. Give the replicated project a new clone project name.
6. Optionally change the mount points of any file systems in the project by using **Override Mountpoint**. Click **Continue**.

The project, including all file systems and LUNs, is now available on the target system. Follow the procedures on adding NFS file systems or iSCSI LUNs in VMware ESX to attach these shares to your ESX server.

5.0 Appendix

This appendix contains a sample workflow script to build an Analytics worksheet for monitoring NFSv3 and iSCSI operations. This workflow should be copied to a text file and then uploaded to the Sun Storage 7000 Unified Storage System by taking the following steps:

1. Select **Maintenance** -> **Workflows**.
2. Click (+) to **Add a Workflow**.
3. Browse to the text file location.
4. Activate Workflow by double-clicking on the name of the workflow.
5. The resulting worksheet can be accessed by selecting **Analytics** -> **Saved Worksheets**.

Below is a workflow example:

```
/*
 * This is an example workflow for building a Analytics worksheet
 * The worksheet is intended to monitor key metrics for NFSv3 and
 * iSCSI operations in a VMware ESX environment
 *
 */


var steps = [ {
       step: 'Checking for existing worksheet',
       execute: function (params) {
              /*
               * In this step, we're going to see if the worksheet that
               * we're going to create already exists.  If the worksheet
               * already exists, we blow it away if the user has indicated
               * that they desire this behavior.  Note that we store our
               * derived worksheet name with the parameters, even though
               * it is not a parameter per se; this is explicitly allowed,
               * and it allows us to build state in one step that is
               * processed in another without requiring additional global
               * variables.
               */
              params.worksheet = 'VMware ESX Worksheet';

              try {
                     run('analytics worksheets select name="' +
                         params.worksheet + '"');

                     if (params.overwrite) {
                            run('confirm destroy');
                            return;
                     }

                     throw('Worksheet called "' + params.worksheet +
                         '" already exists!');
              } catch (err) {
                     if (err.code != EAKSH_ENTITY_BADSELECT)
                            throw (err);
              }
       }
}, {
       step: 'Creating worksheet',
       execute: function (params) {
              /*
               * In this step, we're ready to actually create the worksheet
               * itself. Finally, note that we
               * aren't saving the datasets -- we'll let the user do that
```

```
             * from the created worksheet if they so desire.  (It would
             * be straightforward to add a boolean parameter to this
             * workflow that allows that last behavior to be optionally
             * changed.)
             */
            run('analytics worksheets');
            run('create "' + params.worksheet + '"');
            run('select name="' + params.worksheet + '"');


               if (params.proto == 'iscsi') {
                   ds = [ 'iscsi.ops[client]', 'net.kilobytes', 'io.bytes[disk]',
                           'arc.accesses[hit/miss]'];
               } else if (params.proto == 'nfs') {
                   ds = ['nfs3.ops[file]','nfs3.ops[client]','net.kilobytes',
                       'io.bytes[disk]','arc.accesses[hit/miss]'];
               }
               else {
                  ds = ['nfs3.ops[file]','nfs3.ops[client]', 'iscsi.ops[client]',
                   'net.kilobytes', 'io.bytes[disk]','arc.accesses[hit/miss]'];
               }

            for (i = 0; i < ds.length; i++) {
                  run('dataset');
                  run('set name=' + ds[i]);
                  run('commit');
            }
      }
} ];

var workflow = {
      name: 'VMware ESX Worksheet',
      description: 'VMware ESX Worksheet',
      parameters: {
            overwrite: {
                  label: 'Overwrite the worksheet if it exists',
                  type: 'Boolean'
            },
               proto: {
                        label: 'Protocol',
                        type: 'ChooseOne',
                        options: [ 'nfs', 'iscsi', 'both' ],
                        optionlabels: [ 'NFSv3', 'iSCSI', 'NFSv3+iSCSI' ],
               }
      },
      execute: function (params) { return (steps); }
};
```

6.0 Glossary

The following table contains common abbreviations and acronyms that are used in this document.

Abbreviation	Explanation
ARC	Adaptive Replacement Cache
BUI	Browser User Interface
CHAP	Challenge-Handshake Authentication Protocol
CLI	Command Line Interface
DSA	Digital Signature Algorithm
IPMP	IP Network Multipathing
IQN	iSCSI Qualified Name
iSCSI	Internet Small Computer Systems Interface
LACP	Link Aggregation Control Protocol
LUN	Logical Unit Number
NAS	Network Attached Storage (check)
NFS	Network File System
NIC	Network Interface Card
RAID	Redundant Array of Independent Disks
RDM	Raw Device Mapping
RSA	Algorithm for public-key cryptography
SSH	Secure Shell
VI	Virtual Infrastructure

7.0 For More Information

VMware resources:

- VMware web site: http://www.vmware.com/
- VMware on Sun page: http://www.sun.com/software/vmware/index.jsp
- VMware ESX Server Documentation: http://www.vmware.com/support/pubs/
- VMware Communities: http://communities.vmware.com/home.jspa

Sun Storage resources:

- Sun Storage 7000 Unified Storage System web site: http://www.sun.com/storage/disk_systems/unified_storage
- Sun download site: http://www.sun.com/download/
- Fishworks Blogs: http://blogs.sun.com/fishworks
- Sun Storage Unified Storage System Administration Guide: http://docs.sun.com/source/820-4167-10/
- Other Sun documents at http://docs.sun.com
- Sun training courses at http://www.sun.com/training/, for example, Sun Storage 7000 Unified Storage System Administration (NWS-6425)
- Storage Stop Blog: http://blogs.sun.com/storage
- Discussions:
    - Sun Storage forums: http://forum.java.sun.com/category.jspa?categoryID=66
    - Sun Hardware - Servers forums: http://forums.sun.com/forum.jspa?forumID=830
- Sun BluePrints™ wiki (http://wikis.sun.com/display/BluePrints/Main)
- Sun Storage Administration wiki: http://wikis.sun.com/display/StorageAdmin/Home

BigAdmin resources:

- Storage Tech Tips page on BigAdmin wiki: http://wikis.sun.com/display/BigAdmin/Storage+Tech+Tips
- Virtualization Resources for System Administrators: http://www.sun.com/bigadmin/topics/virtualization/
- Virtualization Resource Collection (includes community submissions): http://www.sun.com/bigadmin/collections/virtualization.jsp
- Storage Resource Collection (includes community content): http://www.sun.com/bigadmin/collections/storage.jsp

Other Sun information:

- Support:
  - Sun resources:
    - Register your Sun gear: https://inventory.sun.com/inventory/
    - Services: http://www.sun.com/service/index.jsp
    - SunSolve[SM]: http://sunsolve.sun.com
  - Community system administration experts: http://www.sun.com/bigadmin/content/communityexperts/
- Events of interest to users of Sun products:
  - Worldwide developer events and Sun Tech Days: http://developers.sun.com/events/
  - Current events: http://www.sun.com/events/index.jsp

8.0 Licensing Information

Unless otherwise specified, the use of this software is authorized pursuant to the terms of the license found at http://www.sun.com/bigadmin/common/berkeley_license.html.